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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/687,713	10/17/2003	Kuci-Wu Huang	N1085-00184 [TSMC2002-132]	4631
54657	7590	01/06/2006	EXAMINER	
DUANE MORRIS LLP IP DEPARTMENT (TSMC) 30 SOUTH 17TH STREET PHILADELPHIA, PA 19103-4196			VINH, LAN	
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 01/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/687,713

Applicant(s)

HUANG ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-38 is/are pending in the application.
- 4a) Of the above claim(s) 31-38 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>101703</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Group I, claims 1-30 in the reply filed on 12/28/2005 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-6, 11-15, 22-23 rejected under 35 U.S.C. 102(a) as being anticipated by De Felipe et al (US 6,541,374)

De Felipe discloses a method for forming diffusion layers in a semiconductor device. The semiconductor device includes a barrier layer on a top surface of a low-k interlayer dielectric layer. The method comprises the steps of:

forming at least two copper interconnect structures within a low-k interlayer dielectric layer 103 (col 2, lines 25-55)

treating the top surface of the low-k interlayer dielectric layer to transform a thin surface layer of the low-k interlayer dielectric layer into a copper diffusion barrier (col 8, lines 5-15; fig. 2D)

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Regarding claimw 2, 11, De Felipe discloses the step of exposing the top surface of the low-k to a plasma treatment/ion implantation includes nitrogen gas (col 6, lines 50-60), the copper diffusion layer barrier is titanium silicon nitride (col 7, lines 57-61)

Regarding claims 3-4, 12-13, De Felipe discloses using nitrogen and ammonia gases (col 6, lines 50-62)

Regarding claims 5-6, 14-15, De Felipe discloses forming a barrier layer having a thickness between 10-100 angstrom (col 8, lines 50-52)

Regarding claims 22-23, De Felipe discloses forming a dual damascene structure includes copper (col 2, lines 59-62; fig. 1G; fig. 2D)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 7-8, 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Felipe et al (US 6,541,374) in view of Sudijono et al (US 2004/0092098)

De Felipe method has been described above. Although De Felipe discloses forming a SiC barrier layer (col 2, lines 25-26), unlike the instant claimed inventions as per claims 7-8, 16-17, De Felipe fails to specifically disclose treating the surface of the low-k with plasma formed from carbon dioxide

Sudijono discloses a method for forming dual damascene comprises the step of treating the surface of a dielectric layer with plasma formed from carbon dioxide gas to form a barrier layer of SiC (col 3, paragraph 0024)

One skilled in the art at the time the invention was made would have found it obvious to modify De Felipe step of forming a SiC layer by treating the surface of the low-k with plasma formed from carbon dioxide as per Sudijono because Sudijono discloses that one process for depositing SiC includes a gas combination containing carbon dioxide (col 3, paragraph 0024)

5. Claims 9-10, 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Felipe et al (US 6,541,374) in view of Sudijono et al (US 2004/0092098) and further in view of Lur et al (US 6,917,109)

De Felipe as modified by Sudijono has been described above. Unlike the instant claimed inventions as per claims 9-10, 18-19, De Felipe and Sudijono fail to disclose the specific thickness of the SiC layer

Lur discloses a method for forming an interconnect comprises the step of forming a copper barrier layer layer SiC having a thickness of 50-500 angstroms (col 7, lines 53-55)

Since De Felipe is directed to a method of forming copper interconnection, one skilled in the art at the time the invention was made would have found it obvious to modify De Felipe and Sudijono by the step of forming a copper barrier layer layer SiC having a thickness of 50-500 angstroms as per Lur because Lur discloses that copper barrier

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layer such as SiN, SiC is deposited to a thickness of 50-500 angstroms and these are materials particularly suited for copper (col 7, lines 54-57)

6. Claims 20-21, 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Felipe et al (US 6,541,374) in view of Okada et al (US 6,583,046)

De Felipe method has been described above. Unlike the instant claimed inventions as per claims 20-21, 24, De Felipe fails to specifically disclose that the low-k dielectric layer is of hydrogen silsesquioxane (HSQ)/polymeric dielectric

Okada, in a method for forming dual damascene, discloses that polymer dielectric such as HSQ has been extensively studied for use as ILD in metallization processing (col 2, lines 51-53)

Thus, one skilled in the art at the time the invention was made would have found it obvious to modify De Felipe method by using HSQ as the low- k dielectric in view of Okada teaching because Okada discloses that material such as HSQ has been considered for use as "gap-fill" between spaced-apart metal lines in view of their flowability and ability to fill very small openings (col 2, lines 54-57)

Regarding claims 25-27, De Felipe discloses applying chemical that contains silicon and nitrogen to form a nitride barrier layer on the surface of the low k while keeping the temperature of the wafer at between 100-400 degree C (col 6, lines 40-51, col 7, lines 45-50)

7. Claims 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Felipe et al (US 6,541,374) in view of Okada et al (US 6,583,046) and further in view of Sudijono et al (US 2004/0092098)

De Felipe as modified by Okada method has been described above. Although De Felipe discloses forming a SiC barrier layer and keeping the temperature of the wafer at between 100-400 degree C (col 2, lines 25-26; col 6, lines 40-51), unlike the instant claimed inventions as per claims 28-30, De Felipe and Okada fail to specifically disclose treating the surface of the low-k with chemical contains carbon

Sudijono discloses a method for forming dual damascene comprises the step of treating the surface of a dielectric layer with carbon dioxide gas to form a barrier layer of SiC (col 3, paragraph 0024)

One skilled in the art at the time the invention was made would have found it obvious to modify De Felipe and Okada by treating the surface of the low-k with plasma formed from carbon dioxide as per Sudijono because Sudijono discloses that one process for depositing SiC includes a gas combination containing carbon dioxide (col 3, paragraph 0024)

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



LV
January 4, 2006